525 Rec'd PCT/PTO 03 NOV 2000

FORM PTO-1390 (Modified) (REV 11-98) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **WLJ.060**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR: 09/ 674660

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/GB00/00796	**6 MARCH 2000**	**4 MARCH 1999**

TITLE OF INVENTION
CHLOROTRIFLUORINE GAS GENERATOR SYSTEM

OIPE JC57 NOV 03 2000 PATENT & TRADEMARK OFFICE

APPLICANT(S) FOR DO/EO/US
Jyoti Kiron BHARDWAJ et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ☐ has been transmitted by the International Bureau.
   - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   - b ☐ have been transmitted by the International Bureau.
   - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U S.C 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ Certificate of Mailing by Express Mail
20. ☐ Other items or information:

526 Rec'd PCT/PTO 03 NOV 2000

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 09/674660	INTERNATIONAL APPLICATION NO PCT/GB00/00796	ATTORNEY'S DOCKET NUMBER WLJ.060

21. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS	PTO USE ONLY
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO	**$1,000.00**		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but Internation Search Report prepared by the EPO or JPO	**$860.00**		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	**$710.00**		
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4)	**$690.00**		
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4)	**$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =		**$860.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	12 - 20 =	0	x $18.00	**$0.00**	
Independent claims	1 - 3 =	0	x $80.00	**$0.00**	
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**	
TOTAL OF ABOVE CALCULATIONS =				**$860.00**	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable)**. ☐				**$0.00**	
SUBTOTAL =				**$860.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				**$0.00**	
TOTAL NATIONAL FEE =				**$860.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable)**. ☒				**$40.00**	
TOTAL FEES ENCLOSED =				**$900.00**	
				Amount to be: refunded	$
				charged	$

☒ A check in the amount of **$900.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. in the amount of to cover the above fees. A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **50-0238** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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SIGNATURE

ADAM C. VOLENTINE
NAME

33289
REGISTRATION NUMBER

NOV. 3, 2000
DATE

09/674660

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent Application of	:	
Jyoti Kiron BHARDWAJ et al.	:	Attn: Applications Branch
Serial No. [NEW]	:	Attorney Docket No.: WLJ.060
Filed: November 3, 2000	:	

Title: CHLOROTRIFLUORINE GAS GENERATOR SYSTEM

PRELIMINARY AMENDMENT

Honorable Commissioner of
Patents and Trademarks,
Washington, D.C. 20231

Sir:

Preliminary to the examination of the above-identified application, please enter the following amendments and consider the following remarks:

IN THE CLAIMS:

Please cancel claim 13 without prejudice.

Please amend the claims as follows:

Claim 3, line 1, delete "or claim 2".

Claim 4, line 1, change "any one of claims 1 to 3" to --claim 1--.

Claim 5, line 1, change "any one of claims 1 to 4" to --claim 1--.

Claim 9, line 2, change "any one of claims 1 to 8" to --claim 1--.

REMARKS

By this Preliminary Amendment, claim 13 has been canceled, and claims 3, 4, 5, and 9 have been amended to eliminate the multiple dependent claims. Entry of this Preliminary Amendment is respectfully requested.

Respectfully submitted,

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Date: November 3, 2000

"Chlorotrifluorine Gas Generator System"

Chlorotrifluorine (ClF_3) is known to be a likely candidate to achieve an improved etch process capability and has recently become increasingly utilised as a "dry chamber-clean" gas to remove very effectively deposits and build-up after other plasma processes. This is more effective and used in preference to gases such as NF_3 which are also highly toxic, but require plasma or other excitation means to allow etching at acceptable rates.

The prior art comprises two alternative methods of ClF_3 supply, either using a conventional cylinder containing the precursor gas or by local electrolytic cell generation. Cylinder ClF_3 gas delivery systems are most commonly used and have been discussed in detail by Verma et al (Semiconductor International, July 1997, p253). Issues such as compatibility of installation materials and thermal gradients require particular attention. These design considerations can have a significant impact on the overall performance of the process.

Supply of ClF_3 has been available in liquid cylinder form and, very recently, developments have focused on the availability of "dry" cartridge delivery systems. This allows the delivery of ClF_3 (in a nitrogen carrier gas), with the advantages that there are neither liquid filled cylinders of extremely hazardous ClF_3 to be transported nor any special storage requirements on-site, as the dry cartridge is solid at ambient temperatures. A limitation

of either the liquid cylinder or dry cartridge ClF_3 delivery system is that they are both subject to fluctuations in the ambient conditions, which could affect the process reproducibility. ClF_3 (which is a liquid at ambient temperature) is delivered from a conventional cylinder as a low vapour-pressure gas. To achieve the high gas flow rates and pressures required for processing, a single cylinder using an external-heating jacket is commonly used. This poses additional facilitation and safety requirements in order to prevent gas condensation in the delivery lines and components. The situation may be further aggravated depending upon application. For example if the gas is used in applications where it may be switched with another process gas, then the changes in the flow demands of the process may cause the gas to liquefy in the gas lines. This is because of the variable pressure, temperature and flow parameters experienced by the gas delivery system during this process.

Newer delivery systems based on electrolytic cell generation overcome some of these limitations. Such systems are only just becoming commercially available. An example is a fluorine gas generator cell as described in US Patent No. 5688384. However a dedicated ClF_3 delivery installation is still needed. Limitations of this dry cartridge ClF_3 delivery system include gas flow fluctuations caused by changes in the ambient conditions which will, in turn, affect the process reproducibility. The cost of the

process gas is similar to that for supply of ClF_3 in liquid form but the dry cartridges require exchanging and this will require a service infrastructure and support to be established. In addition, this method only allows ClF_3 to be generated in the presence of an N_2 carrier gas.

ClF_3 suffers from a combination of increased cost over existing chemistries, greater health and safety risks and limited commercial availability. These factors combine to make the economics and practicalities of implementing this chemistry potentially difficult and/or the installation and transportation thereof extremely hazardous.

According to the invention there is provided a ClF_3 gas generation system wherein supply sources of chlorine and fluorine are connected into a gas reaction chamber enabling generation of ClF_3 gas, and the reaction chamber has a valved outlet for the supply of the ClF_3 gas.

The invention further extends to such a gas generator system wherein the valved outlet from the reaction chamber is connected to a single or multiple process chamber or processing tool or multiple tools in which the ClF_3 gas will be utilised. A tool may have more than one chamber. This invention provides for the generation of ClF_3 process gas on demand. The ClF_3 is generated locally to the process tool through the direct combination of the precursor gases, fluorine and chlorine, under controlled temperature and pressure reaction conditions. The use of the individual precursor gases offers a considerable improvement over many

of the economic, and handling constraints of current methods of supplying ClF_3. In particular, the recent commercial availability of an appropriately scaled local high-purity fluorine generator overcomes many of the safety issues of handling pure high-purity fluorine required for the reaction.

"Locally" (or point of use) means that the delivery system is located near to a process chamber or a number of chambers or number of systems near to one another, so that the gases created can be delivered directly to the chamber or system for immediate use rather than being created off-site and transported in a suitable container for subsequent introduction into the apparatus.

Direct reaction of Cl_2 and F_2 allows the local generation of the ClF_3 although the specific reaction products resulting from the reaction may include other reaction by-products species in the form of Cl_xF_y, (and very small quantities of Cl_2 and F_2) but the dominant species can be maintained as ClF_3. Apart from the reaction by-product species, the generated gas can be formed to the same high purity levels as the precursor gases. This high purity is easier to maintain in a smaller scale reaction chamber compared to much larger commercial volume generation systems. For the majority of applications envisaged, the reaction by-product species defined above are not expected to represent any detrimental process issues over ClF_3 alone. Other benefits of this invention include lower production

cost and ownership costs as well as reduced hazard to personnel.

The reaction chamber can be formed from high purity materials (such as those sold under the Trade Marks Monel (nickel/copper/iron alloy), Inconel (nickel/chromium/iron alloy) and Hastalloy (nickel/molybdenum/chromium/manganese /iron alloy)) which would not be financially feasible with large scale generation systems.

The gas generator for the invention operates with known precursor gases at or near atmospheric pressure, thus virtually eliminating the need for specialised gas delivery systems. Ideally though the gas generation system will be provided with a control system to control the rate of supply of gases from the two supply sources and through the valved outlet from the reaction chamber.

The reaction chamber may be operated at or near atmospheric pressure, going up the range from several Torr to 760 Torr. The reaction chamber temperature can be controlled at between ambient room temperature up to 600°C generally, but probably will lie within the range of 100 - 400°C. Differing temperatures may be maintained in at least 2 separate zones of the reaction chamber.

The most hazardous gas used in the installation will be Cl_2, which is already commonly used in most fabrication plants in the utilisation of semiconductor manufacturing techniques. Other than this, there are no extremely hazardous gases in the installation, until the process

demands gas generation (of fluorine gas, followed by ClF_3). This reduces hazardous chemical storage problems and risk of corrosion etc. Long gas lines for the local generation of fluorine on demand from a central store on the installation to the processing environment are eliminated along with the associated risks. Specialised gas delivery systems, containing hazardous chemicals, to the process equipment are also eliminated, which reduces the level of safety precautions needed to protect the operator during use and during any maintenance operations. The generation of the process gas from the ClF_3 gas generator is very competitive as compared with the cost requirement using high-pressure cylinders for the actual gas supply. There would be a significant reduction in the installation cost due to the reduced amount of pipe work for the additional gases and the associated safety requirements such as gas monitoring systems.

A chlorine supply source may comprise a cylinder of compressed chlorine or a chlorine generator. A fluorine supply source may be a fluorine generator.

The direct combination of precursor gases can provide ClF_3 for the process chamber by passing the relatively safe precursor gases through a simple heated and pressure-controlled reaction chamber that is local to the tool. The design of the system will be such as to avoid possible adverse reactions during the combination of the precursor gases that may prejudice the overall process. The ClF_3

reaction chamber design allows operation at pressures independent of the process chamber pressure. This can be achieved by allowing the gas product to flow into the process chamber via a pressure control system. The process chamber is then independent of the higher pressure in the reaction chamber and the delivery pressure of the supplied fluorine and chlorine.

The introduction of high purity gases removes the need to "polish" the generated ClF_3 to remove unwanted impurities before passing into the process chamber. The generation of fluorine locally to the tool overcomes the commercial difficulties in obtaining high purity 100% fluorine in a high pressure cylinder and in the quantities required. The choice of supply of chlorine is from high-pressure cylinders, which are commercially readily available and commonly installed within the industry. Other appropriate methods of chlorine simply may be used. Mass flow controllers may be used to precisely meter the flow of Cl_2 and F_2 into the reaction chamber.

The safety requirements for the precursor gases are already commonplace for the targeted industry. This is not the case for chlorotrifluorine. The production of chlorotrifluorine within a sub-component of a process tool eliminates additional safety precautions that would need to be taken for the supply of such gas from a centralised store. The maintenance of the complete system is eased by

the absence of any ClF_3 when the system is not being used for processing.

The quantity of the generated gases can be regulated to that required for the specific application so that the gas consumption is optimised and excess generated gas avoided. The design of a custom-built fluorine-on-demand generator ensures that the ClF_3 is only produced as required from the reaction chamber. The flow rates that can be achieved are not subject to gas delivery restrictions which might be prescribed for ClF_3 delivery from a central store.

The invention may be performed in various ways and preferred embodiments thereof will now be described, by way of example, with reference to the accompanying drawing, in which:-

Figure 1 is a diagrammatic illustration of a typical system of the invention;

Figure 2 illustrates the effect of gas ratio variations on silicon etch rate; and

Figure 3 is a diagrammatic illustration of a further example of a direct combination ClF_3 generator.

The system shown in the drawing is for supplying chlorotrifluorine to a process chamber 1 where a dry process utilising that gas is to take place. The ClF_3 is delivered from a local reaction chamber 2 where precursor gases chlorine and fluorine are combined under conventional heat and pressure controlled conditions. The chlorine source is a cylinder 3 of compressed chlorine. The

fluorine source is a conventional fluorine generator 4. Appropriate valving will include valves provided at A, B, C and D for appropriate isolation and control means. Linked control systems 5 and 6 monitor and maintain the supply to and conditions in the chambers 1 and 2.

From the process chamber gases pass to an exhaust system 7, which in turn leads to an abatement tool 8 (which is usually needed). A bypass outlet 9 leads from the reaction chamber 2 to the exhaust system, whereby gases can be switched into the process chamber 1 only when required for processing. This also allows means for ensuring stable gas composition and flow to be maintained prior to switching into the process chamber.

The following equations indicate the steps of generating a ClF_3 gas.

(1) $Cl_2 + F_2 \rightarrow 2ClF$

(2) $2ClF + 2F_2 \longleftrightarrow 2ClF_3$

Equation 1 shows the first step in the formation of ClF_3 from the reaction of Cl_2 and F_2. This occurs at temperatures in the range of 250 to 500°C (preferably 350 to 400°C) at atmospheric pressure. The second reaction step shown in equation 2 occurs at lower temperatures in the range of 200 to 350°C (preferably 250 to 300°C) at atmospheric pressure. Hence, the ClF_3 reactor system may comprise two different temperature controlled zones (or independent reactors), to control the individual reaction steps. Depending on the partial pressure of ClF_3 required

a single reactor design may be sufficient, in this case operating at 250 to 350°C.

Details of the reactor design include:

1. premixing of the F_2 and Cl_2 using a static mixing technology, with low pressure drop throughout the reactor system (<50 Torr)
2. an HF trap located between the F_2 generator and the mixing stage
3. a high temperature reactor using static mixing technology (to improve heat transfer to enhance reaction kinetics and ensure effective mixing of the gases $Cl_2+F_2+ClF_x$)
4. minimising temperature hot spots and ensuring that controlled thermal gradients are used.

The use of ClF_3 necessitates a pre-conditioning of the gas lines and reactor/chamber surfaces to avoid any deleterious reactions, which may compromise safety (CJ Gugliemini and AD Johnson Semiconductor International, June 1999, pp 162-166). This pre-conditioning is necessary after every occasion where the surfaces have been exposed to the ambient atmosphere, which includes any maintenance operations. Ideally the pre-conditioning must be carried out using F_2. An additional feature of the present invention is the ability readily to perform the F_2 pre-conditioning. Practically this can be achieved for the whole system by flowing the F_2 only, with the reactor system between room and operational temperature, and

operating the respective valving in order to pre-condition the necessary components of the system. If the pre-conditioning (and thermal cycling) of the reactor system is to be avoided, then a bypass valving arrangement can be used.

Where ClF_3 is required for plasma applications, it may be sufficient simply to combine the gases in a mixing manifold prior to entry into the plasma chamber without any specialised reaction chamber. As the plasma collisions serve to ionise the gas(es), so that the combination of radical and charged particle fluxes are used to carry out the processing, the function of ClF_3 may be equally well served by flowing appropriate ratios of F_2:Cl_2. Figure 2 shows the result of etching silicon, comparing a ClF_3 plasma with a F_2:Cl_2 gas mixture. The result shows that the etch rate peaks at approximately 18-30% chlorine, which is in a similar range as the ratio of Cl:F as in ClF_3. Thus one embodiment of the present invention is the use of a Cl_2/F_2 gas mixture (preferably at 15 to 35% Cl, preferably 20-30% Cl) to replace the need for ClF_3.

One embodiment of the invention is the use of an additional ClF_x holding chamber 11 (shown in Figure 3) which serves to allow immediate gas flow on demand to reduce the processing time associated with generation startup or initialisation. The holding chamber is

controlled to a temperature in the range 25 to 200°C (preferably 25 to 100°C) at atmospheric pressure.

In Figure 3, items similar to those in the embodiment 8 Figure 3 are given similar reference numerals. In this embodiment F_2 and Cl_2 are supplied via respective control valves A and B to a pre-treatment static mixer 10. From the static mixer 10 the pre-mixed gases pass to a first reaction chamber 2a to allow reaction (1) above to take place and thence to a second reaction chamber 2b where reaction (2) takes place. The reaction mixture from the second reaction chamber 2b is then passed to a holding chamber 11, maintained at a required temperature and pressure, whence the reaction mixture passes via a valve 12 and flow meter 14 to the process chamber 1. The process chamber has an outlet connection to a pump system/abatement device 7,8. Also, the second reactor 2 may pass the reaction mixture direct to the pump system/abatement device 7,8 via a by-pass valve 15, to by-pass the holding chamber 11 and the process chamber 1. The flow bypass may be required for stabilisation purposes or, where the holding chamber is not present, for disposing of the reaction mixture during loading/unloading of the process chamber.

Also shown in the Figure is a source 16 of a purge gas for allowing purging of the system, under control of a valve E.

CLAIMS

1. A ClF_3 gas generation system wherein supply sources of chlorine and fluorine are connected into a gas reaction chamber enabling generation of ClF_3 gas, and the reaction chamber has a valved outlet for the supply of the ClF_3 gas.

2. A system according to claim 1, wherein the chlorine supply source comprises a cylinder of compressed chlorine or a chlorine generator.

3. A system according to claim 1 or claim 2, wherein the fluorine supply source is a fluorine generator.

4. A system according to any one of claims 1 to 3, wherein a control system is provided to control the rate of supply of gases from the two supply sources and through the valved outlet from the reaction chamber.

5. A system according to any one of claims 1 to 4, wherein the valved outlet from the reaction chamber is connected to a process chamber or processing tool or multiple tools in which the ClF_3 gas will be utilised.

6. A system according to claim 5, wherein an abatement tool is connected from the output of the processing chamber or tool.

7. A system according to claim 6, wherein a bypass connection is provided from the reaction chamber to the abatement tool to enable the process to build up to a

stable composition and/or flow prior to supply of the generated ClF_3 to the process chamber or tool.

8. A system according to claim 6, wherein a bypass connection is provided from the reaction chamber to the abatement tool to enable the flow of ClF_3 to be switched into the process chamber as and when required to allow a continuous generation of ClF_3.

9. A method of generating ClF_3 gas using a system as claimed in any one of claims 1 to 8, wherein the precursor gases are fed from the supply sources to the reaction chamber, a combination reaction is performed and the ClF_3 reaction product is fed on to a local processing chamber or tool.

10. A method according to Claim 9 wherein the gasses formed are fed into a plasma chamber using Cl_2/F_2 gas mixture, wherein the chlorine level is between 15-35%, preferably 20-30%.

11. A method according to Claim 9 wherein an additional ClF_x gas is provided in a holding chamber which allows immediate gas flow on demand to reduce processing time.

12. A method according to Claim 9 wherein the gas lines and reactor surfaces are pre-conditioned using F_2.

13. A gas generation system or method for generating ClF_3 gas and substantially as herein described with reference to the accompanying drawings.

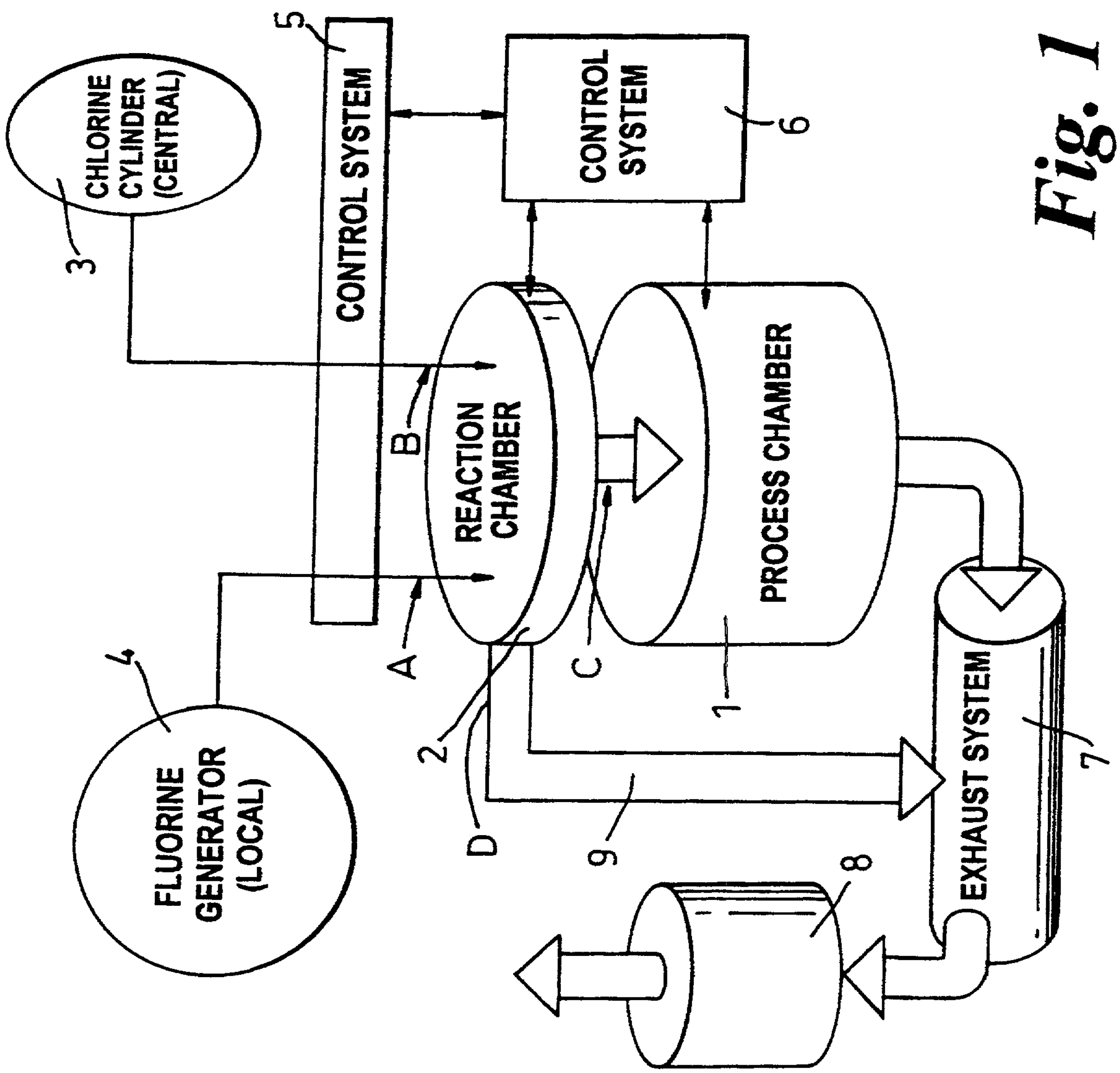
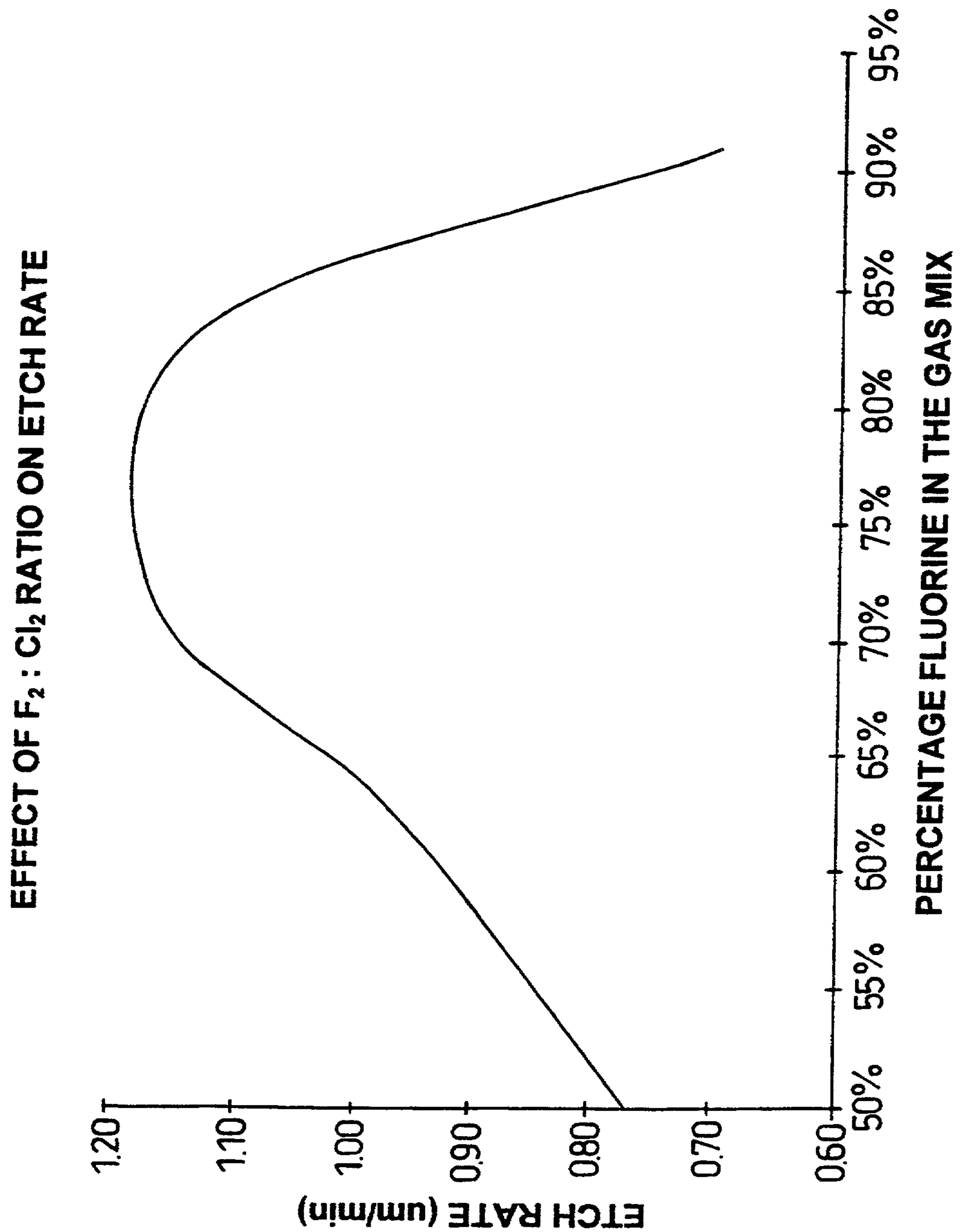

CHLORINE CYLINDER (CENTRAL)
3
5
CONTROL SYSTEM
CONTROL SYSTEM
6
B
A
REACTION CHAMBER
PROCESS CHAMBER
C
2
1
FLUORINE GENERATOR (LOCAL)
4
D
9
EXHAUST SYSTEM
7
8

Fig. 1

09/674660
PCT/GB00/00796



INFLUENCE OF GAS MIXTURE RATIO ON THE SILICON ETCH RATE

Fig. 2

3/3

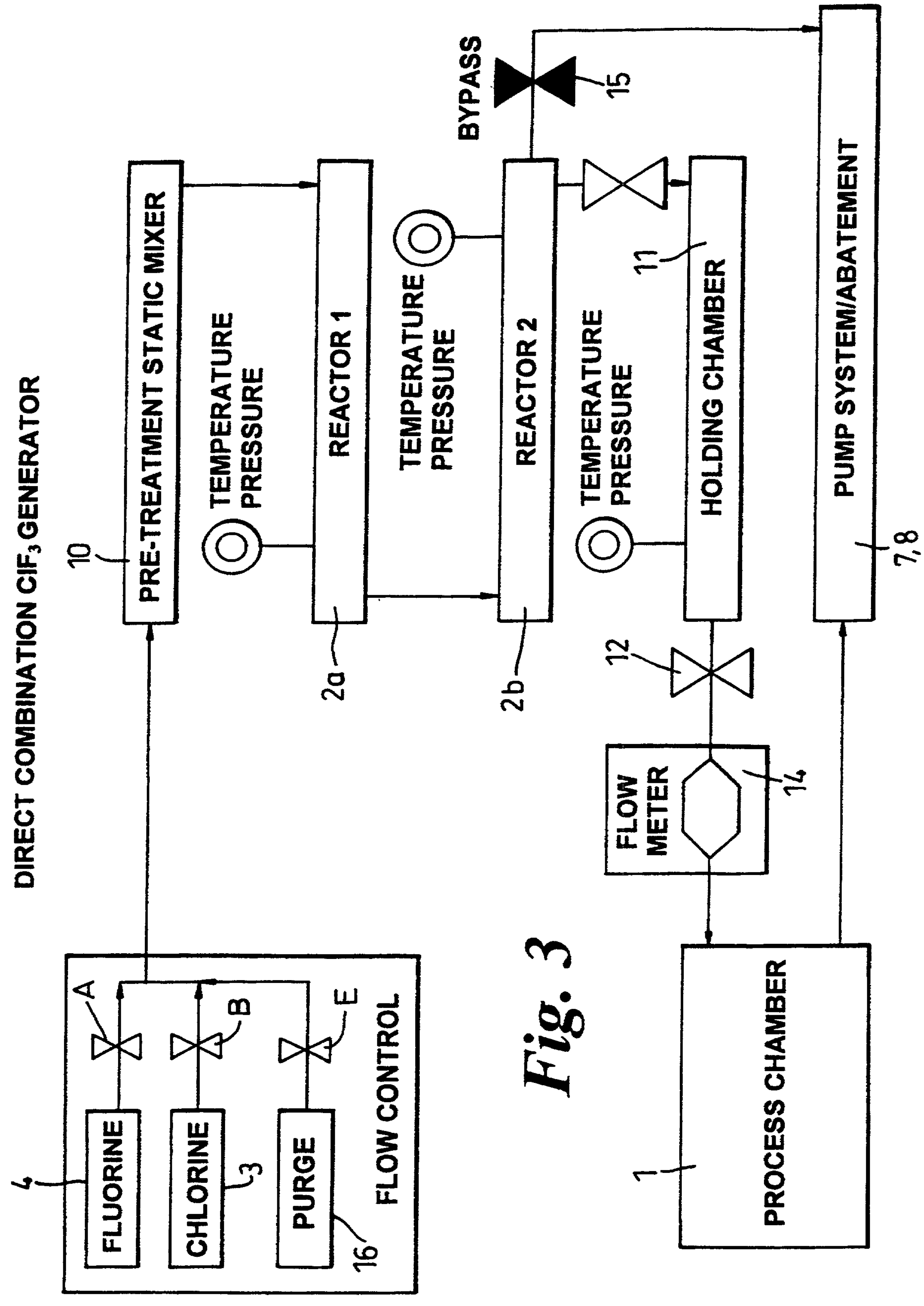

DIRECT COMBINATION ClF3 GENERATOR
FLUORINE
CHLORINE
PURGE
FLOW CONTROL
A
B
E
4
3
16
PRE-TREATMENT STATIC MIXER
10
TEMPERATURE
PRESSURE
REACTOR 1
2a
TEMPERATURE
PRESSURE
REACTOR 2
2b
BYPASS
15
TEMPERATURE
PRESSURE
HOLDING CHAMBER
11
12
FLOW METER
14
PROCESS CHAMBER
1
PUMP SYSTEM/ABATEMENT
7,8

Fig. 3

JONES VOLENTINE, L.L.C. (6/2000)

DECLARATION AND POWER OF ATTORNEY FOR U.S. PATENT APPLICATION

(X) Original ( ) Supplemental ( ) Substitute ( ) PCT ( ) Design

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE: **CHLOROTRIFLUORINE GAS GENERATOR SYSTEM**

of which is described and claimed in:

( ) the attached specification, *or*

( ) the specification in the application Serial No.__________________ filed__________________,

and with amendments through__________________ (if applicable), *or*

(X) the specification in International Application No. PCT/GB00/00796, filed 6 MARCH 2000,

and as amended on __________________ (if applicable).

I hereby state that I have reviewed and understand the content of the above-identified specification, including the claims, as amended by any amendment(s) referred to above.

I acknowledge my duty to disclose information of which I am aware which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (and §172 if this application is for a Design) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NO.	DATE OF FILING	PRIORITY CLAIMED
GREAT BRITAIN	9904925.6	4 MARCH 1999	YES
GREAT BRITAIN	9909856.8	29 APRIL 1999	YES

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NO.	U.S. FILING DATE	STATUS: PATENTED, PENDING, ABANDONED

And I hereby appoint Raymond C. Jones, Reg. No. 34,631 and Adam C. Volentine, Reg. No. 33,289, of the firm of JONES VOLENTINE, L.L.C., jointly and severally, attorneys to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith.

I hereby authorize the U.S. attorneys named herein to accept and follow instructions from WYNNE-JONES, LAINE & JAMES as to any action to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and myself. In the event of a change in the persons from whom instructions may be taken, the U.S. attorneys named herein will be so notified by me.

Kindly direct all correspondence to: **JONES VOLENTINE, L.L.C.**
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Suite 150
Reston, Virginia 20191

Telephone (703) 715-0870

Full Name of 1st Inventor 1-00	FAMILY NAME BHARDWAJ	FIRST GIVEN NAME Jyoti	SECOND GIVEN NAME Kiron
Residence & Citizenship	CITY Bristol	STATE OR COUNTRY Great Britain GBN	COUNTRY OF CITIZENSHIP Great Britain
Post Office Address	ADDRESS 60 Campion Drive, Bristol BS12 0BH, Great Britain	CITY	STATE OR COUNTRY / ZIP CODE
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I further declare that all statements made herein of my own knowledge are true, and that all statements on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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